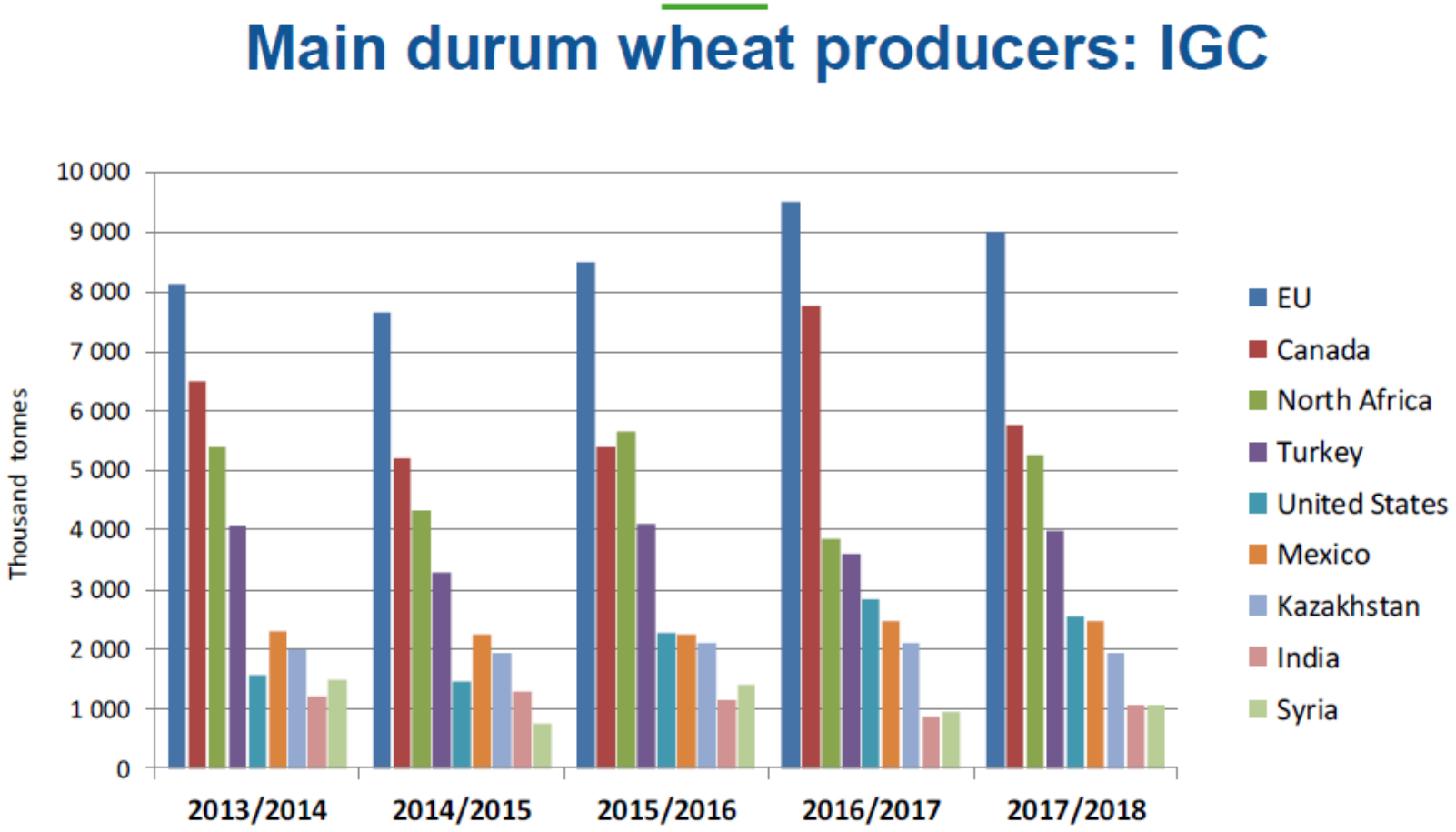
MED-GOLD

Living Lab 2021
A problem from the durum wheat sector

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776467

Durum wheat production in the world



Willems. E. Durum wheat market. An EU perspective. DG Agriculture Unit G.4 2017

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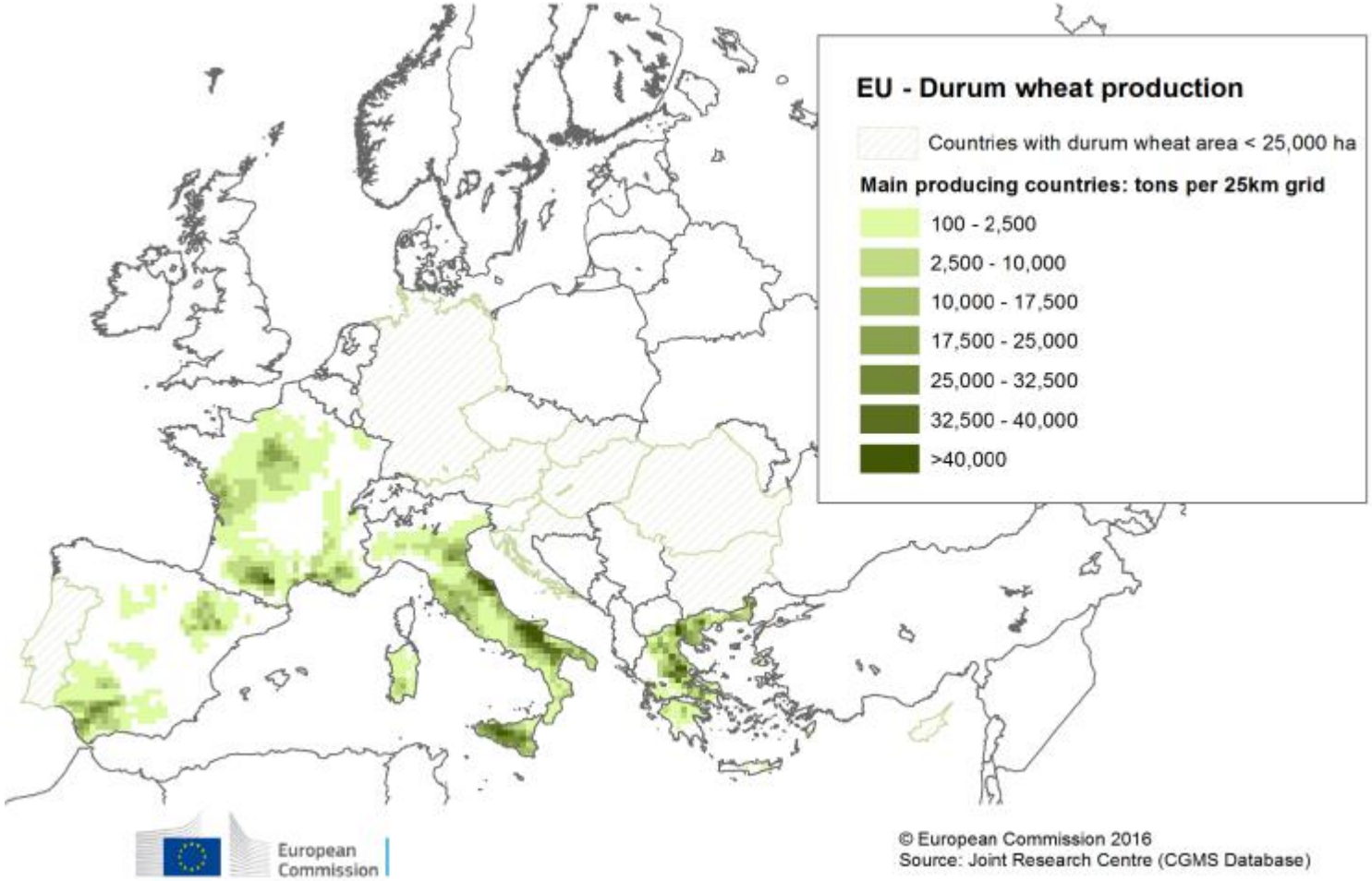
Areas of durum wheat production in the EU



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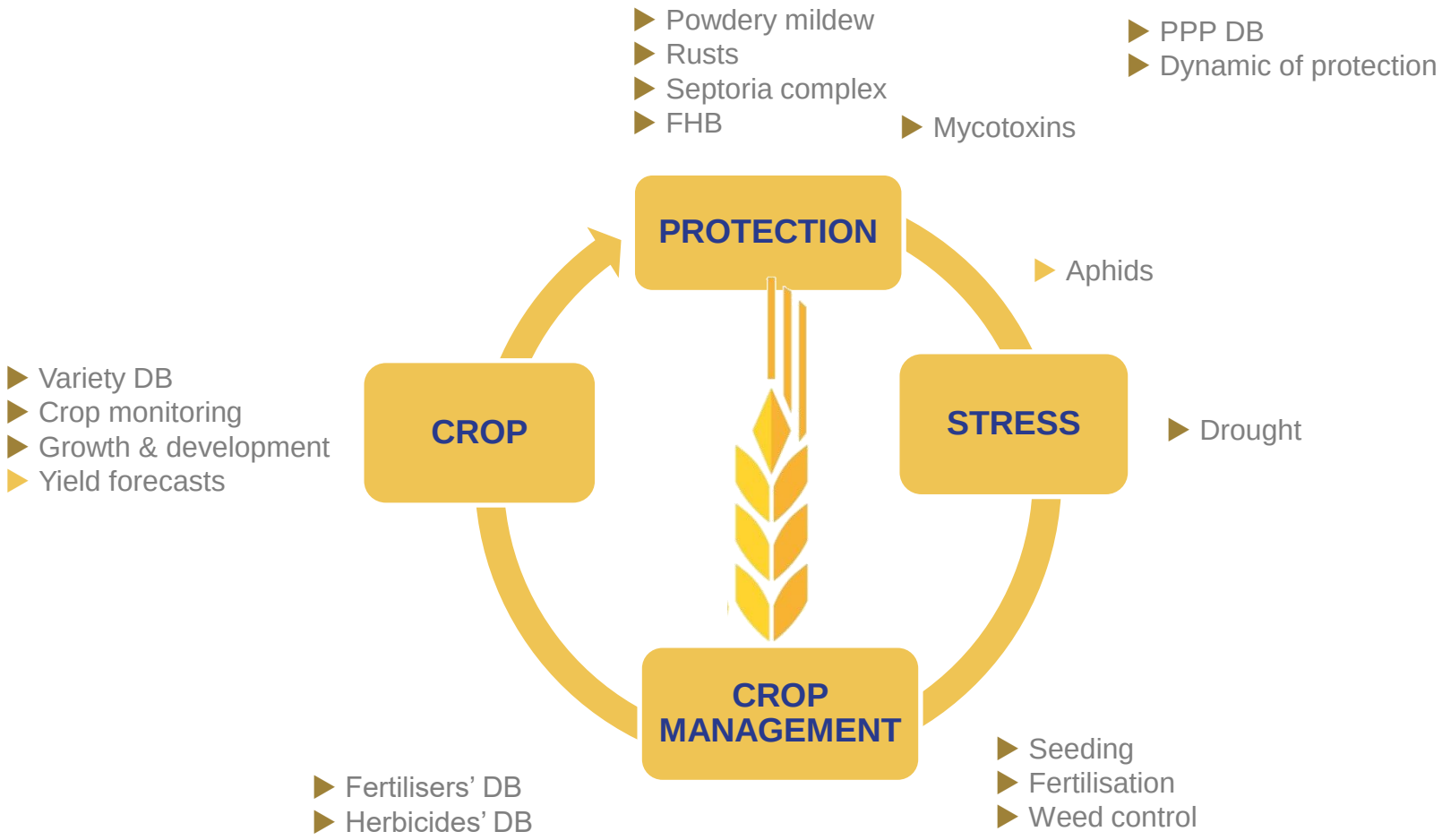
Horta's Decision Support System



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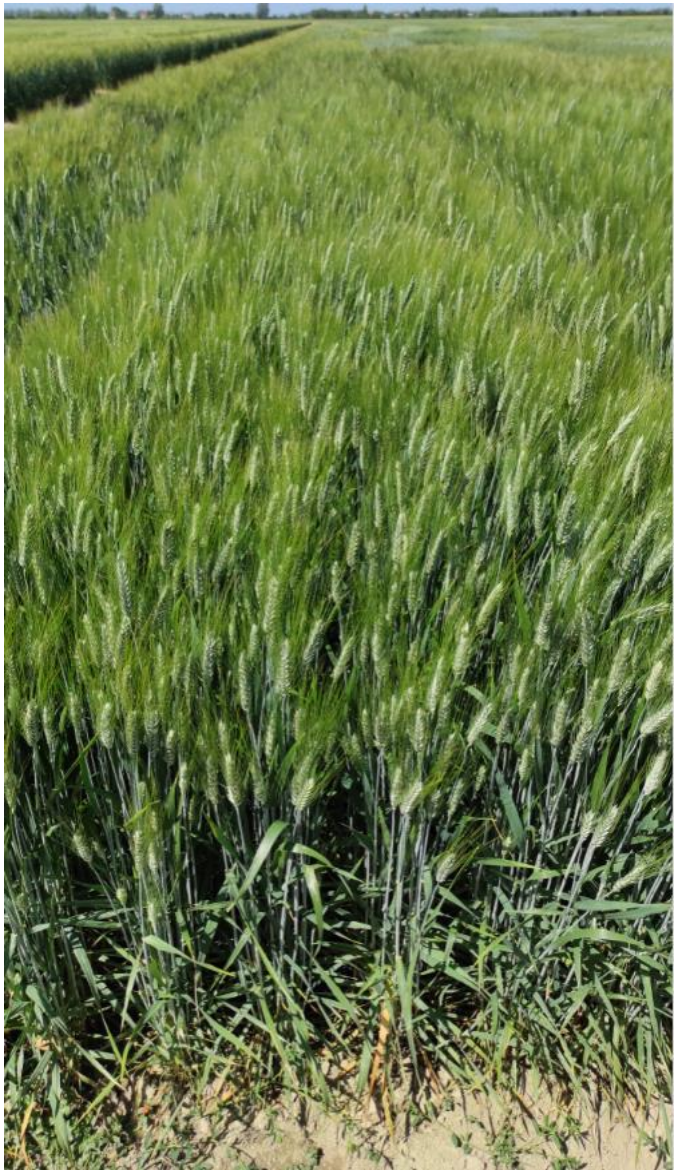
The problem

How the crop manager of durum wheat should use the seasonal forecast to optimize nitrogen fertilization to increase yields and quality?



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Data:

Durum wheat yield average: 7 t/ha of grain
Price of durum wheat: 285 €/ton

How to define the fertilization plan for Nitrogen:
30 units of nitrogen are needed per hectare and per ton of grain produced.
A unit of nitrogen represents the kilograms of N contained in 100 kg of fertilizer.

Characteristics of main N fertilizers:
Urea 46% --> 100 kg urea = 46 nitrogen units.
Urea is a fertilizer providing nitrogen with medium/low release, so uptake by the plant is not rapid, but the fertilizer is less prone to leaching

Ammonium nitrate 27% --> 100 kg ammonium nitrate = 27 nitrogen units
Ammonium nitrate is a fertilizer providing nitrogen with fast release, so uptake by the plant is rapid, but the fertilizer is also more prone to leaching.

Price of fertilizers:
0,42 €/kg for urea 46%
0,27 €/kg for ammonium nitrate 27%

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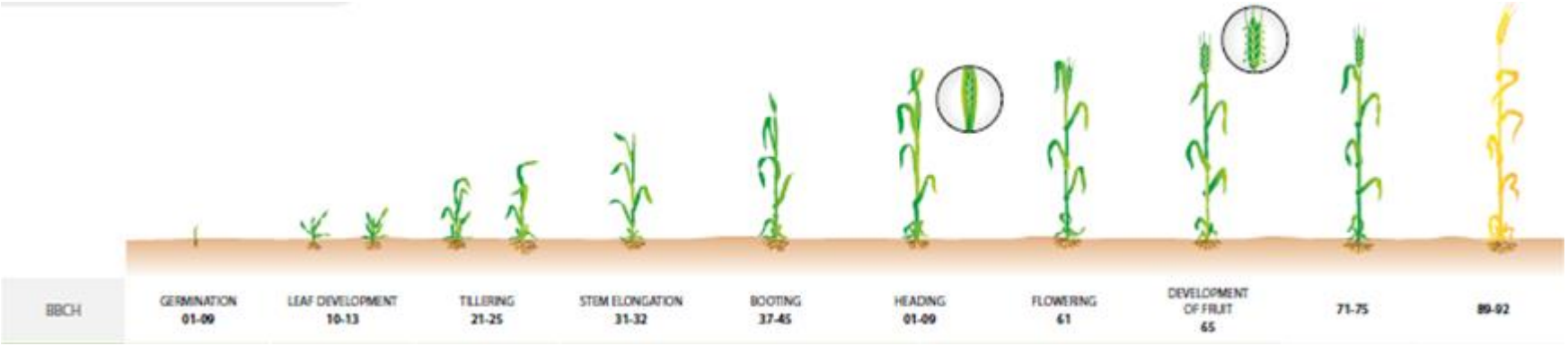
Consideration about wheat fertilization

1) Sowing is in October/November, Harvesting is in June.



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2) Drivers for defining fertilization needs:

- For the dose to be applied: expected yields, quality, weather (mainly rainfalls), previous crop and soil features.
- For the timing of application: total nitrogen dose, plant needs, plant uptake, leaching risk.

In case there is a humid season, loss of N by leaching needs to be considered in the planning, the amount of N needs to be increased. In case of a dry season, there are problems for N uptake by the plant and response of the plant to fertilization, the amount of N needs to be decreased.

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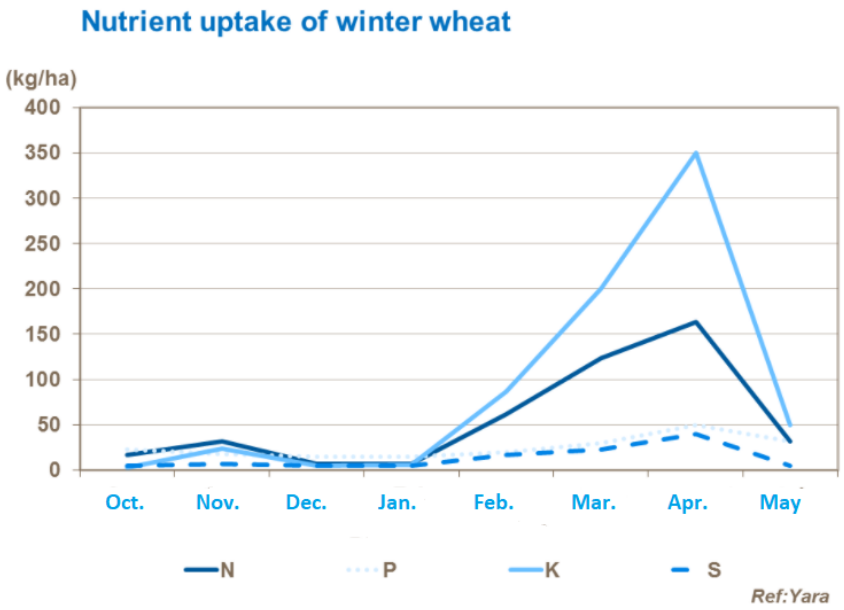
3) 40% of nitrogen needed is already available in the soil.

4) Nutrient uptake by the plants varies during the cropping season, following crop phenology. It is higher during stem elongation.



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5)The total amount of nitrogen to be distributed needs to be split into several interventions, in general maximum 100 units can be distributed at each fertilization intervention.
Usually 2 to 4 fertilizations are carried out, splitting in more interventions is not economically convenient for the farmer.

6) Phenological stages suitable for application of N fertilizers are:

Usually only one intervention is carried out in each phenological stage.

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6) Usually farmers apply N fertilizers according to one of these techniques:

- before sowing; tillering; beginning of stem elongation
- tillering; beginning of stem elongation
- tillering; beginning of stem elongation; booting
- before sowing; tillering; beginning of stem elongation; booting

It is also possible to apply microgranular fertilizers at sowing, or foliar fertilizers at heading or flowering. However, these are less common techniques, and these kind of fertilizers only have few N units (2-10, max 20).

7) Rainfalls above 20 mm/day pose challenges to accomplishing fieldwork. Wet soil is vulnerable to compaction, so machinery cannot enter the field.

8) Farmers usually don't stock fertilizers in the farm, they buy what is strictly necessary in the season. Purchase is usually done short time before spreading in the field.

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Indexes for seasonal forecasts

During the MED-GOLD project, some indexes have been identified for their relevance for durum wheat. The indexes which can have a relevance for fertilisation are:

Description	Type of index	Technical value
Hydrological balance during tillering	SPEI (StandardisedPrecipitation-Evapotranspiration Index)	The index can give support for the application of nitrogen fertilizers, which is a critical decision at this stage.
Number of days with rain above 10 mm during tillering period	number of days	
Number of days with rain above 40 mm during tillering	number of days	
Hydrological balance between beginning of stem elongation period and end of booting	SPEI (Standardised Precipitation-Evapotranspiration Index)	The index can give support for the application of nitrogen fertilizers, in the period when the crop has the higher demand for nutrients.

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